REMARKS

Please consider the following comments. Following this response, claims 1, 2, and 4-16 are pending. Applicant respectfully requests reconsideration and allowance of this application in view of the above amendments and the following remarks.

Claim Objections

The Examiner has objected to claims 4 and 15 based on a number of informalities.

With respect to claim 4, the Examiner has noted that in line 1, the claim recites "The method according to claim 3 1", and requests that this be changed to "The method according to claim 1". By this response, Applicant has made this correction.

With respect to claim 15, the Examiner has requested that the term "between 0.05 and 0.1" in line 3 be changed to read "between 0.05 micrometers and 0.1 micrometers" to reflect the units used in this claim. By this response, Applicant has made this correction.

Based on these two amendments, Applicant respectfully submits that the identified informalities have been corrected and ask that the Examiner withdraw the objection to claims 4 and 15.

Claim Rejections – 35 U.S.C. § 103

The Examiner has rejected claims 1, 5, 7, 11, and 13 under 35 U.S.C. § 103(a) as being allegedly unpatentable over United States Patent No. 6,469,345 to Aoki et al. ("Aoki") in view of United States Patent No. 6,350,665 to Jin et al. ("Jin") and further in view of United States Patent No. 6,350,665 to Henley et al. ("Henley").

By this response Applicant has amended claims 1 and 11 to recite that the annealing of the substrate is "for improvement of reliability of the insulation film", to clarify what is meant by

this operation. Nothing in Aoki, Jin, or Henley, alone or in combination, discloses or suggests this feature.

The Examiner acknowledges that Aoki fails to disclose annealing a substrate, as recited in claims 1 and 11. For this teaching he relies upon Jin. However, Jin fails to disclose that the annealing temperature be equal to or higher than 1150 degrees Celsius and be equal to or less than 1200 degrees Celsius. For this he relies upon the teachings of Henley. However, Henley discloses annealing removing defects in the surface region of wafers between cleaving steps, and so fails to disclose or suggest that the annealing be for "improvement of reliability of the insulation film," as required by claims 1 and 11.

In particular, Henley states that in some applications "it is beneficial to prepare the surface of the donor substrate prior to repeating the cleaving sequence. For example, pulled silicon crystals are know to contain vacancy-related defects (e.g. COP defects). These defects at the surface region of the wafers can be removed by applying an annealling [sic] step at 1200° C. [sic] for several seconds." Henley further notes that "[s]uch a surface treatment generally improves the crystalline quality of the silicon surface." (See, e.g., Henley, column 14, lines 8-18.)

But this treatment in Henley is disclosed as being done after a thin film is cleaved off a doped substrate, and before subsequent implantation and cleaving steps are performed. In particular, the annealing step in Henley is provided to improve the crystallinity of the cleaved silicon surface. Nothing in Henley discloses or suggests that an annealing step be performed in the manufacture of a trench gate device, or that it be performed after the step of forming a conductive film or when an insulation film is present (as would be required by the language of amended claims 1 and 11).

The Examiner asserts that it would have been obvious to one of ordinary skill in the art to incorporate the annealing temperature of Henley into the process of Aoki and Jin since one of ordinary skill in the art would have been motivated to modify Aoki and Jin as disclosed in Henley for the purpose of improving the crystalline quality of the silicon surface. (See, e.g., Henley, column 14, lines 15-18.) Applicant strongly traverses this assertion.

As noted above, the annealing process in Henley is performed to prepare the surface of the donor substrate prior to repeating the cleaving sequence, i.e., after one cleaving process is performed and before another is performed. Thus, it is done on a bare substrate, i.e., one without any other structures or films deposited on it. In fact, the very purpose of the high-temperature annealing process is to correct certain vacancy-related defects (e.g., COP defects) that result on the substrate from pulled silicon crystals after a cleaving process. Such a motivation is meaningless with respect to a substrate that already has a film (e.g., an insulation film or conductive film) deposited on it. Therefore there is not proper motivation to apply the teachings of Henley to the Examiner's combination of Aoki and Jin.

Furthermore, Henley specifically states that the annealing process is to "prepare the surface of the donor substrate *prior to repeating the cleaving sequence.*" (Emphasis added.) The Examiner's combination of Aoki and Jin does not disclose or suggest that even a single cleaving sequence be performed. Therefore there would be no motivation to apply the teachings of Henley to the teachings of these two documents.

In fact, even the combination of the teachings of Jin with the teachings of Aoki is not proper, given the language of amended claims 1 and 11. Jin simply discloses that a heat treatment step (524) could be performed sometime after planarization of an interlayer dielectric to repair any damage arising from the deposition of the interlayer dielectric. But Jin specifically

notes that this is a step to be used if the interlayer dielectric is borophosphosilicate glass (BPSG), but may be omitted for a method that includes HDP PSG. (See, e.g., Jin, column 13, lines 44-53, and FIG. 5.) There is no indication as to why this would suggest that such a step be performed for improvement of reliability of the insulation film after the step of forming the conductive film so that damage in the insulation film is removed at the annealing temperature, as required by claims 1 and 11, or even that this step would be required where an oxide film or a doped polycrystalline silicon layer (as is used in Aoki) is employed.

The Examiner asserts that that it would have been obvious to one of ordinary skill in the art to incorporate the annealing step of Jin into the method of Aoki since one of ordinary skill in the art would have been motivated to modify Aoki as disclosed in Jin for the purpose of repairing damages arising from the deposition of an interlayer dielectric layer. But there is no suggestion that Jin's process, which is used for a BPSG layer, would have any applicability to the oxide layer or the doped polycrystalline silicon layer disclosed in Aoki. Thus, one skilled in the art at the time of the present invention would have had no motivation to incorporate the heat treatment of Jin into the process disclosed in Aoki.

Claims 5 and 7 depend from claim 1 and are allowable for at least the reasons given above for claim 1. Claim 13 depends from claim 11 and is allowable for at least the reasons given above for claim 11.

Therefore, for at least the reasons given above, Applicant respectfully requests that the Examiner withdraw the rejection of claims 1, 5, 7, 11, and 13 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, and further in view of Henley.

The Examiner has rejected claims 2, 6, 8-10, 14, and 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of United States Patent No. 6,455,378 to Inagawa et al. ("Inagawa").

Claims 2, 6, and 8-10 depend variously from claim 1 and are allowable for at least the reasons given above for claim 1. Claims 14 and 15 depends from claim 11 and are allowable for at least the reasons given above for claim 11.

Nothing in Inagawa cures the deficiencies in Aoki, Jin, and Henley noted above. In particular, nothing in Inagawa discloses or suggests that the annealing of the substrate be for improvement of reliability of the insulation film, or be performed after the step of forming the conductive film, as recited in amended claims 1 and 11. Furthermore, nothing in Inagawa provides any motivation to combine the teachings of Henley with those of Aoki and Jin.

In addition, with respect to claim 15, the Examiner concedes that Aoki, Jin, Henley, and Inagawa together fail to disclose the distance between the edge of a canopy and the edge of an opening of a trench being in the range of 0.05 micrometers and 0.1 micrometers.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claims 2, 6, 8-10, 14, and 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of Inagawa.

The Examiner has rejected claim 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of Inagawa. However, it appears from the language of this rejection that the Examiner intends for this rejection to also be based on United States Patent No. 6,159,781 to Pan et al. ("Pan").

Claim 15 depends from claim 11 and is allowable for at least the reasons given above for claim 11. Nothing in Pan cures the deficiencies in Aoki, Jin, Henley, and Inagawa noted above.

In particular, nothing in Pan discloses or suggests that the annealing of the substrate be for improvement of reliability of the insulation film, or be performed after the step of forming the conductive film, as recited in amended claim 11. Furthermore, nothing in Pan provides any motivation to combine the teachings of Henley with those of Aoki and Jin.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 15 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, further in view of Inagawa, and further in view of Pan.

The Examiner has rejected claim 12 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of United States Patent No. 6,218,866 to Poplevine ("Poplevine").

Claim 12 depends from claim 11 and is allowable for at least the reasons given above for claim 11.

Nothing in Poplevine cures the deficiencies in Aoki, Jin, and Henley noted above. In particular, nothing in Poplevine discloses or suggests that the annealing of the substrate be for improvement of reliability of the insulation film, or be performed after the step of forming the conductive film, as recited in amended claim 11. Furthermore, nothing in Poplevine provides any motivation to combine the teachings of Henley with those of Aoki and Jin.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 12 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of Poplevine.

The Examiner has rejected claim 16 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of United States Patent No. 6,218,300 to Narwankar et al. ("Narwankar").

Claim 16 depends from claim 11 and is allowable for at least the reasons given above for claim 11.

Nothing in Narwankar cures the deficiencies in Aoki, Jin, and Henley noted above. In particular, nothing in Narwankar discloses or suggests that the annealing of the substrate be for improvement of reliability of the insulation film, or be performed after the step of forming the conductive film, as recited in amended claims 1 and 11. Furthermore, nothing in Narwankar provides any motivation to combine the teachings of Henley with those of Aoki and Jin.

Applicant therefore respectfully requests that the Examiner withdraw the rejection of claim 16 under 35 U.S.C. § 103(a) as being allegedly unpatentable over Aoki in view of Jin, further in view of Henley, and further in view of Narwankar.

Conclusion

For all the reasons advanced above, Applicants respectfully submit that pending claims 1, 2, and 4-16, as amended are allowable.

In view of the foregoing, Applicants respectfully submit that this application is in condition for allowance. A timely notice to that effect is respectfully requested. If questions relating to patentability remain, the examiner is invited to contact the undersigned by telephone.

Please charge any unforeseen fees that may be due to Deposit Account No. 50-1147.

Respectfully submitted,

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